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(54) Title: A METHOD FOR PRODUCING AN OPTICAL REGISTRATION CARRIER BY MEANS OF A MASTER MOULD, A DEVICE SUITABLE FOR CARRYING OUT SUCH A METHOD, AN OPTICAL REGISTRATION CARRIER, A METHOD FOR VERIFYING SUCH AN OPTICAL REGISTRATION CARRIER

(57) Abstract

A method for producing, by means of a master mould, an optical registration carrier which is provided with at least one programme which comprises information stored in the form of variations in a physical parameter. A master mould is made by means of an encoder and a laser beam recorder, wherein the laser beam recorder is driven from the encoder for storing at least said programme on the master mould. Random verification positions are generated thereby, after which coordinates of the verification positions are encrypted into verification information. The verification information is stored in the programme and verification effects are stored at said verification positions.

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A method for producing an optical registration carrier by means of a master mould, a device suitable for carrying out such a method, an optical registration carrier, a method for verifying such an optical registration carrier.

The invention relates to a method for producing, by means of a master mould, an optical registration carrier which is provided with at least one programme which comprises information stored in the form of variations in a physical parameter, wherein a master mould is made by means of an encoder and a laser beam recorder, wherein the laser beam recorder is driven from the encoder for storing at least said programme on the master mould.

The invention furthermore relates to a device which is suitable for carrying out such a method.

The invention furthermore relates to an optical registration carrier provided with at least one programme which comprises information stored in the form of variations in a physical parameter.

The invention furthermore relates to a method for verifying such an optical registration carrier.

The encoder and the laser beam recorder may be integrated in one apparatus, or they may be separate devices, which cooperate with each other. The encoder generates information by means of which the intensity of the laser and of the laser beam is modulated for storing the programme on the master mould.

When producing optical registration carriers, such as CD's, CD-ROM's, DVD's and the like in a conventional manner, music and user information, among other things, are stored in a so-called active programme of the registration carrier. General information with regard to the music and information such as coordinates of the beginning and the end of a particular part, among other things, is stored in a so-called passive programme.

The passive programme inter alia comprises the lead-in and lead-out sectors on the registration carrier, whilst the active programme is that part of a registration carrier on which the user data is stored. With some registration carriers there is no such distinction between passive and active programmes, they only comprise an active programme.

When making the master mould by means of which the eventual registration carriers are produced, the user data and additional information is supplied to an encoder, which encoder generates the information as it is to be stored on the registration carrier, that is, the passive programme (the lead-in and lead-out sectors) and the active programme. In the encoder, error-correcting techniques (for example CIRC) are carried out, and the information is processed with an 8 to 14 modulation (EFM), for example. CIRC and EFM are techniques which are used for CD registrations, for DVD registration carriers this is a Reed Solomon Product code and 8 to 16 modulation, for example. The EFM signal is then transmitted to a laser beam recorder, by means of which a photosensitive film present on a glass disc is exposed. The glass disc is subsequently subjected to a chemical treatment and the glass master mould is obtained. The master mould may then be used for producing moulds. The master mould or the moulds made by means of said master mould are used for producing the plastic registration carriers, CD's etc., by means of an injection moulding technique.

As is described inter alia in CA-2,165,532, the eventual registration carriers such as CD's, CD-ROM's etc., are frequently copied illegally. In order to verify whether a registration carrier has been sold legally, use is made of an SID code, among other things. The SID code is stored on the master mould by means of the laser beam recorder, and subsequently transferred to the registration carrier via the metal mould. The SID code is a visible code which contains information on the laser beam recorder or the encoder that has been used.

The SID code has a number of drawbacks.

If the SID code is not correctly stored in the laser beam recorder, it will be easy to leave out the SID code when using the laser beam recorder, or to substitute the code illegally by a code from a third party.

In this manner it is relatively easy to produce illegal registration carriers which are indistinguishable from legally produced registration carriers.

It is an object of the invention to provide a method for producing optical registration carriers by means of a master mould, wherein the registration carrier is provided with a hallmark which is practically impossible to copy, thus making it possible to distinguish

clearly between legally and illegally produced registration carriers.

This objective is accomplished with the method according to the invention in that random verification positions are generated, after which coordinates of the verification positions are encrypted into verification information, whereupon said verification information is stored in the programme and verification effects are stored at said verification positions.

In this manner it is relatively easy to store the verification effects on the master mould, which verification effects will subsequently form a hallmark for an authentic, original registration carrier.

Since the verification information is encrypted or encoded, it is possible to store secret information at secret places on the registration carrier. The term encrypting is thereby understood to mean the processing of the verification information by means of encryption techniques, so that it will not be immediately apparent what information the verification information comprises. It is possible thereby to use ASCII or binary encoding.

The presence of the verification effects, which are stored at encrypted or encoded verification positions, makes it relatively easy to distinguish between legals registration carriers and illegal registration carriers.

When the registration carrier is being copied illegally, the information stored on the registration carrier can be copied bit by bit. The bit sequence contains errors, however, which are corrected by error correction methods when the registration carrier is being played in a normal manner by the equipment which is required for that purpose. If the complete bit sequence is copied, said errors will also be copied, of course, and new errors will be introduced as a result of said copying, as a result of which the total number of errors will result in a decreased quality of the illegal registration carrier.

Another method is to play the information which is stored on a registration carrier by means of suitable equipment, and make use of the error correction methods. The digital information obtained in this manner can subsequently function as a base for producing good illegal registration carriers.

The provision of predetermined verification effects at encoded verification positions provides various possibilities of verifying whether a registration carrier has been produced legally. The verification effect stored at a verification position may for example be an error in the bit sequence which has been intentionally introduced, which error is corrected by the error correction methods when a registration carrier is being played. When copying takes place bit by bit, the error in question will not be removed and relatively poor illegal registration carriers will be obtained.

When the information is copied and error correction methods are used, the intentionally introduced errors will be removed, as a result of which the illegal registration carrier can be recognized by the absence of the verification effects which are expected at the verification positions.

In addition to that it is possible to store other intentionally introduced errors at the verification positions, such as a deviation as regards the track position, track width, track depth, etc. Said errors are not copied, either, when copying bit by bit. As a result of this, it has become practically impossible to copy illegally in a way that it is not possible to know from the illegal registration carrier whether it is an illegal version or an original one.

It is noted that from Dutch patent application No. 8703032 a method is known for storing on an information carrier characteristic data, such as the exact location of a physical modification on the information carrier. Said patent application does not relate to optical registration carriers, however. Furthermore, it is not possible to derive from said patent application the manner in which an optical registration carrier can be produced and be provided with a finger print, as it were, which is unique for that specific optical registration carrier.

Furthermore it is noted that from European patent application EP-A1-0 644 474 a method is known for securing an optical registration carrier against illegal copying. According to said patent application a registration carrier is made first, after which errors contained in a registration carrier are utilized for additionally storing a key on said registration carrier. With the method according to the invention, a master mould is made, by means of which registration carriers are produced which are directly provided with the desired programme, with

the verification information and with the verification effects present at the verification positions.

In preferred embodiments, the encoder and/or laser beam recorder identification code is encrypted as well. As a result of this, it is practically impossible to interfere with the laser beam recorder drive via the software, as a result of which the identification codes will always be present on the registration carrier, and it can be traced immediately when an illegal copy is found by which laser beam recorder and/or encoder the master mould required for the registration carrier has been made.

It is possible to arrange the encoder and the laser beam recorder in such a manner that said apparatuses check one another, as it were, for the presence of a suitable code, and that they will only co-operate with each other after mutual approval.

If the identification code is stored in the programme, it is practically impossible to prevent the correct identification code associated with the laser beam recorder and/or the encoder being stored on the master mould.

The invention furthermore relates to a method for verifying the registration carrier, which method is characterized in that said verification information is decoded by means of a key code, as a result of which the verification positions become known, after which the verification effects present at the verification positions are compared with the expected verification effects.

The key for decoding the verification positions from the verification information and the verification effects to be found at said verification positions must only be available to authorized parties, of course.

The invention will be explained in more detail hereafter with reference to the drawings, wherein:

Figure 1 is a diagrammatic representation of a device according to the invention;

Figures 2A-2D diagrammatically show information stored on registration carriers according to the invention;

Figures 3 and 4 diagrammatically show part of the structure of a CD registration carrier and a DVD registration carrier respectively;

Figures 5A-C show various alternative possibilities for verification information.

Like parts are numbered alike in the figures.

Figure 1 diagrammatically shows a laser beam recorder 1 and an encoder 2, which each comprises an associated identification code 3, 4. The encoder furthermore comprises a verification positions generator 5, by means of which random verification positions HC can be generated. The encoder 2 is furthermore provided with means, which are known per se, for driving the laser beam recorder 1. Encoder 2 and laser beam recorder 1 may be separate units or be integrated into one system.

Laser beam recorder 1 comprises a verification information generator 6. Both the laser beam recorder 1 and the encoder 2 comprise an encryption unit 7, 8 at an output.

The operation of the device according to the invention is as follows. When a master mould is to be made, the system controller starts laser beam recorder 1 and encoder 2. Encoder 2 and laser beam recorder 1 are coupled, and the laser beam recorder identification code LBR ID is transmitted from laser beam recorder 1 to encoder 2 via encryption unit 7 and encryption unit 8. The presence of the double encryption units 7, 8 makes it practically impossible to find out the laser beam recorder identification code LBR ID. From the encoder, the encoder identification code (encoder ID) is transmitted to the laser beam recorder in a reverse manner via encryption units 8, 7. Both in laser beam recorder 1 and in encoder 2 it is verified whether the apparatus coupled therewith has identified itself correctly. Then coordinates of a number of random verification positions are generated by means of encoder 2, and it is indicated from laser beam recorder 1 which verification effects are to be stored at said verification positions. Subsequently, the encoder identification code, laser beam recorder identification code, coordinates of the verification positions and verification effects to be stored at verification positions are encrypted by encoder 2, after which the encoder transmits the bit signal to laser beam recorder 1. Following that, a laser beam is emitted from laser beam recorder 1, by means of which the photosensitive layer present on the master mould to be made is exposed. It is practically impossible for the system controller to interfere in this process.

Figures 2A-2B globally show the information stored on a CD and a DVD, wherein the portion indicated AP is the active programme and the portions to the left and to the right thereof constitute the passive programme. In the case of a CD registration carrier, said portions are called the lead-in LI and the lead-out LO programme respectively. According to the invention, the verification information comprising the identification codes of the laser beam recorder and the encoder as well as the coordinates of the verification positions is preferably stored in the passive programme at ID1 and ID2 . Subsequently, the expected verification effects are stored at said verification positions in the active programme.

Figure 2C shows a registration carrier wherein both the verification information and the verification effects are stored in the active programme.

Figure 2D shows a registration carrier which is only provided with an active programme, wherein the verification information as well as the verification effects are stored in the active programme.

In Figures 2A-2D, "-" indicates the normal information, "+" indicates the boundaries between active and passive programmes, "=" indicates the verification information, and "~" indicates the verification positions and the verification effects stored thereat.

The verification effect is for example a recessed (pit) or an elevated (land) portion of a clearly deviating length, for example 20 clock pulses. Normally, only lengths of for example maximally 11 clock pulses are permitted. When a registration carrier which is provided with information having a length of 20 clock pulses is being played, correction takes place by means of error correction methods. The EFM signal from the registration carrier can be analysed by means of a time interval analyser (TIA), and the information having a deviating length can be traced relatively easily.

Alternative verification effects are shown in Figures 5A-C, wherein Figure A shows pits 10 positioned one behind the other, not in a circular path, but in a path comprising a predetermined wave.

Figure 5B shows verification effects wherein the width B of pits 12 is different from that of pits 10.

In Figure 5C, the verification pits 13 are positioned higher than the surrounding pits 14.

Of course it is possible to store various already known verification effects at the various verification positions, whereby unauthorized persons do not know which verification effects are present at which verification positions. Since the list of verification positions is furthermore encoded, it is practically impossible for an unauthorized person to produce an illegal registration carrier which contains all verification effects.

Figures 3 and 4 show a part of the passive programme of a CD registration carrier and a DVD registration carrier respectively, whereby the encoder identification code (encoder ID), the laser beam recorder identification code (LBR ID), the time and the data of recording (time + date rec ID1) and the encoded verification positions (phase effects list) are stored in the passive programme. Preferably, said verification information is present on the registration carrier a number of times in order to prevent loss of information, for example in the case of the damage to the registration carrier.

In addition to that it is possible to store the verification information in that part of the passive programme which is not read by means of normal playback equipment.

In the case of playback equipment of a CD registration carrier, a reading spot is moved to a position in the lead-in portion, after which a so-called Table of Contents is read. Once the information of the Table of Contents is complete, the reading spot is moved to the start of the active programme. The verification information is preferably written at the end of the lead-in portion, where the reading spot normally does not come. Thus, it is possible to indicate a position where the reading spot normally does not come for the lead-out portion as well.

Since it is preferred to generate a new sequence of verification positions and associated verification effects for each new master mould, and since it is possible to vary the verification effects stored at the verification positions as well, if desired, it has become impossible to illegally copy registration carriers which will be hallmarked as legal. The copying of registration carrier is not made impossible by the methods and the devices according to the invention, therefore, but they make it possible to identify whether a registration carrier has been produced legally or illegally. Since it is preferred to store the code relating to the laser beam recorder and/or the encoder used for making

the master mould simultaneously with the production of the registration carrier, it is easy to trace whose equipment has been used for making the master mould when an illegal registration carrier is detected. This will discourage the owner of the laser beam recorder and the encoder to a large degree from giving his assistance in illegal practices.

It is also possible for the coordinates of the verification positions to be generated in the laser beam recorder and/or in the system controller, or in both the encoder and the laser beam recorder or the system controller.

In addition to storing information on the devices that have been used, it is also possible to store other relevant information, such as the point in time at which the registration carrier was produced or the geographic position of the laser beam recorder by means of Global Positioning techniques or information which is specific for the title.

The method may also be used in a CD or DVD recorder or in another device for writing on optical media in a simple manner.

Not every CD-R registration carrier comprises a so-called lead-in or lead-out portion (passive programme), so that in the case of a CD-R registration carrier the verification information must be stored in a portion of the active programme which will not be consulted when the CD-R is being played.

CLAIMS

1. A method for producing, by means of a master mould, an optical registration carrier which is provided with at least one programme which comprises information stored in the form of variations in a physical parameter, wherein a master mould is made by means of an encoder and a laser beam recorder, wherein the laser beam recorder is driven from the encoder for storing at least said programme on the master mould, characterized in that random verification positions are generated, after which coordinates of the verification positions are encrypted into verification information, whereupon said verification information is stored in the programme and verification effects are stored at said verification positions.

2. A method according to claim 1, characterized in that an encoder identification code is encrypted by means of the encoder, after which the encrypted identification code is stored in the programme as verification information by means of said laser beam recorder.

3. A method according to claim 1 or 2, characterized in that a laser beam recorder identification code is stored in the programme as verification information by means of said laser beam recorder.

4. A method according to claim 1, 2 or 3, characterized in that verification effects are stored at the verification positions in the active programme, and that the verification information is stored in the passive programme.

5. A method according to any one of the preceding claims, characterized in that the identification code stored in the laser beam recorder is encrypted in the encoder, together with the encoder identification code, into verification information to be incorporated into the programme.

6. A method according to any one of the preceding claims, characterized in that the encoder identification code is verified by means of said laser beam recorder, and that the laser beam recorder identification code is verified by means of said encoder.

7. A device suitable for carrying out the method according to any one of the preceding claims, wherein the device comprises a laser beam recorder and an encoder coupled therewith, characterized in that said device comprises a random verification positions generator and means for

adapting the programme to be generated by means of said laser beam recorder, wherein the coordinates of the verification positions are stored in verification information in the programme, and wherein verification effects are stored at verification positions in the programme.

8. A device according to claim 7, characterized in that a laser beam recorder identification code stored in the laser beam recorder and/or an encoder identification code stored in the encoder can be processed into verification information by means of said encoder.

9. An optical registration carrier provided with at least one programme which comprises information stored in the form of variations in a physical parameter, which optical registration carrier has been produced by means of a master mould which has been obtained by using a method according to any one of the preceding claims, characterized in that said programme comprises verification information including encrypted coordinates of verification positions on the registration carrier, wherein predetermined verification effects are present at said verification positions.

10. An optical registration carrier according to claim 9, characterized in that said programme comprises verification information, which includes the identification code relating to the device used for producing the registration carrier.

11. An optical registration carrier according to claim 9 or 10, characterized in that said verification positions are distributed at random over the registration carrier.

12. An optical registration carrier according to any one of the preceding claims 9 - 11, characterized in that said verification information is stored in a passive programme, and that said verification effects are stored in an active programme.

13. An optical registration carrier according to claim 12, characterized in that said verification information is stored in a hidden part of the passive programme.

14. An optically writeable registration carrier provided with at least one programme which comprises information stored in the form of variations in a physical parameter, which has been produced by means of a recorder, characterized in that said programme comprises verification information which includes encrypted coordinates of verification positions on the registration carrier, wherein predetermined verification effects

are present at the verification positions.

15. A method for verifying an optical registration carrier according to any one of the preceding claims 9 - 14, characterized in that said verification information is decoded by means of a key code, as a result of which the verification positions become known, after which the verification effects present at the verification positions are compared with the expected verification effects.

16. A method according to claim 15, characterized in that the identification code of the device becomes known as a result of said decoding of the verification information.

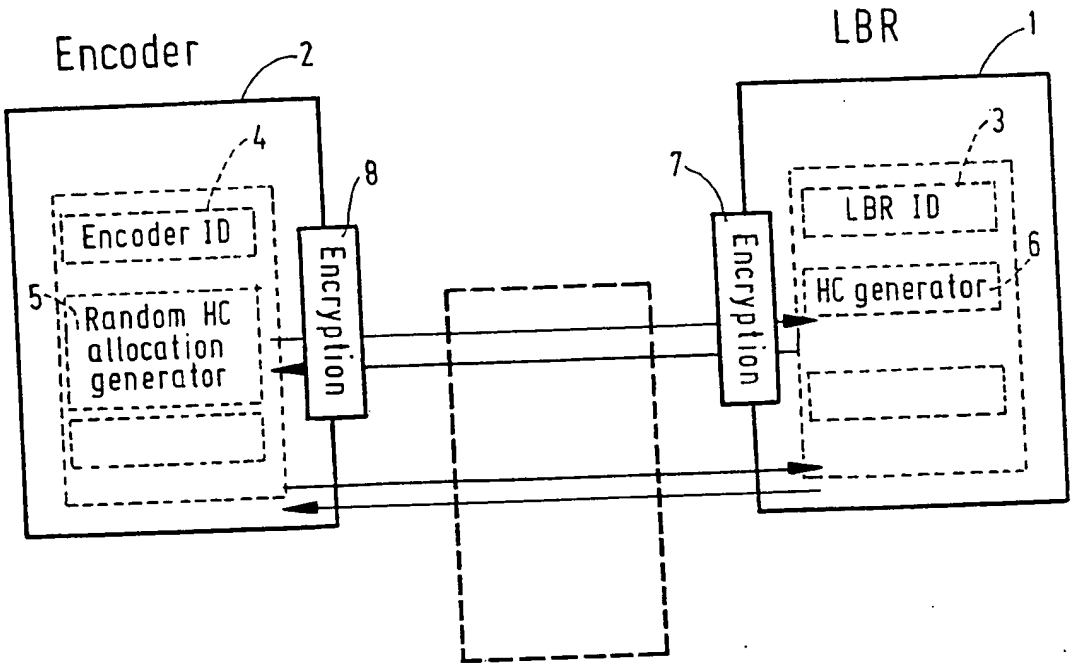
Encoder
2
LBR
1
3
4
8
7
Encoder ID
LBR ID
Encryption
Encryption
6
5
Random HC allocation generator
HC generator
System controller

FIG.1

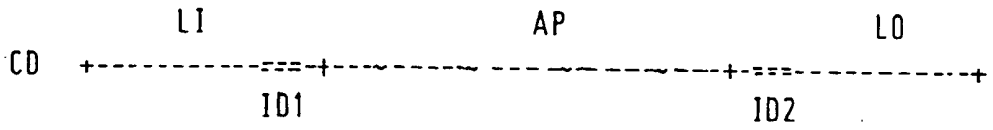

FIG. 2A

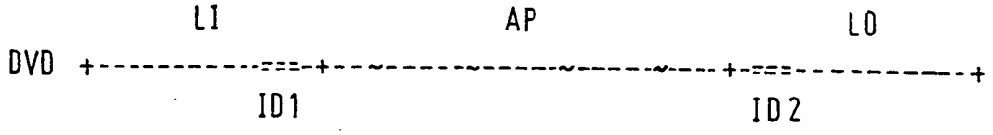

FIG. 2B

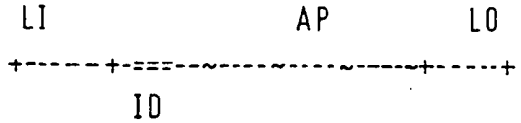

FIG. 2C

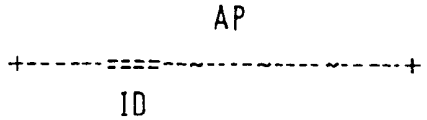

FIG. 2D

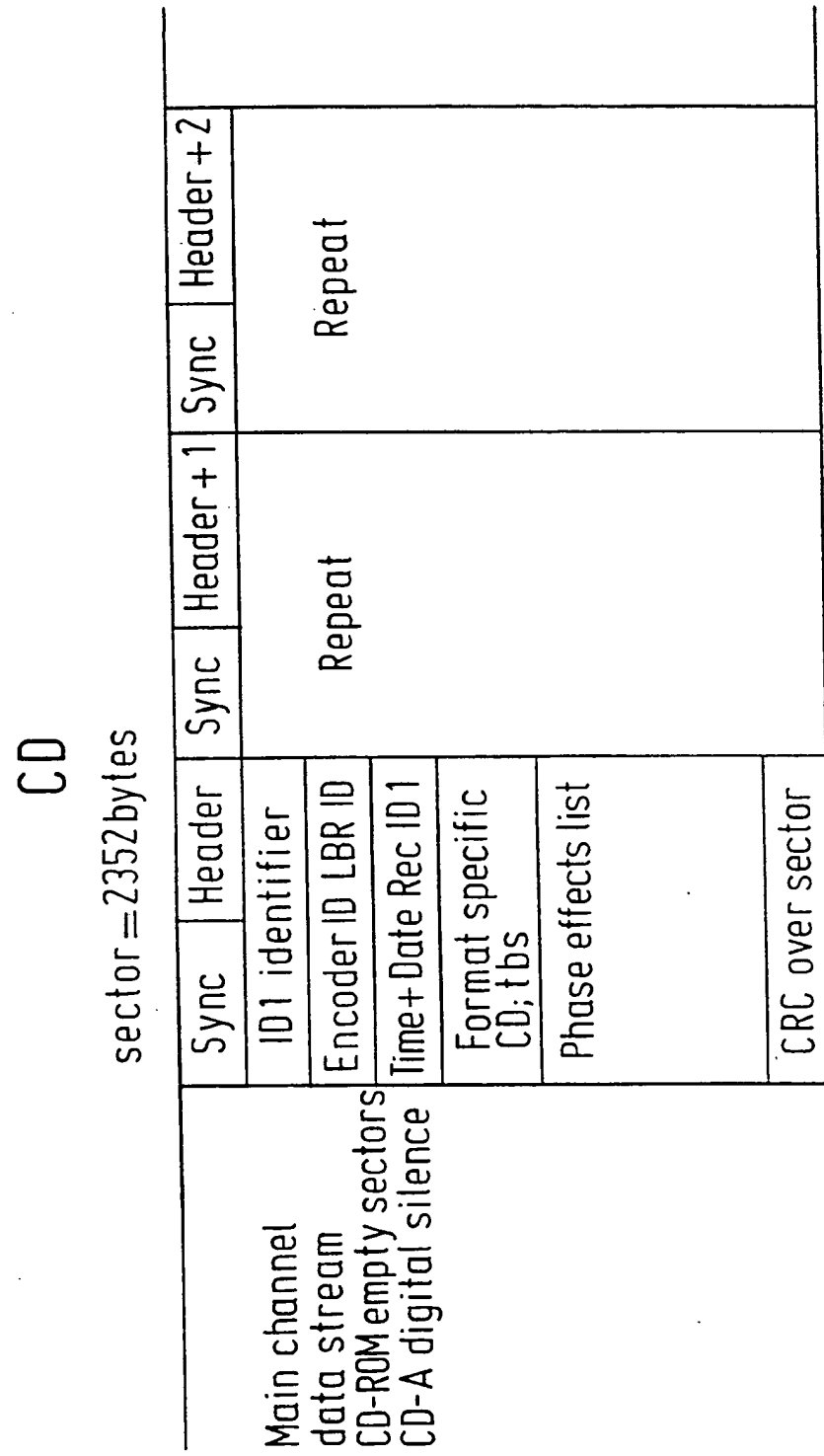
CD
sector = 2352 bytes
Main channel data stream
CD-ROM empty sectors
CD-A digital silence
Sync
Header
ID1 identifier
Encoder ID LBR ID
Time+Date Rec ID1
Format specific CD; tbs
Phase effects list
CRC over sector
Sync
Header+1
Repeat
Sync
Header+2
Repeat

FIG. 3

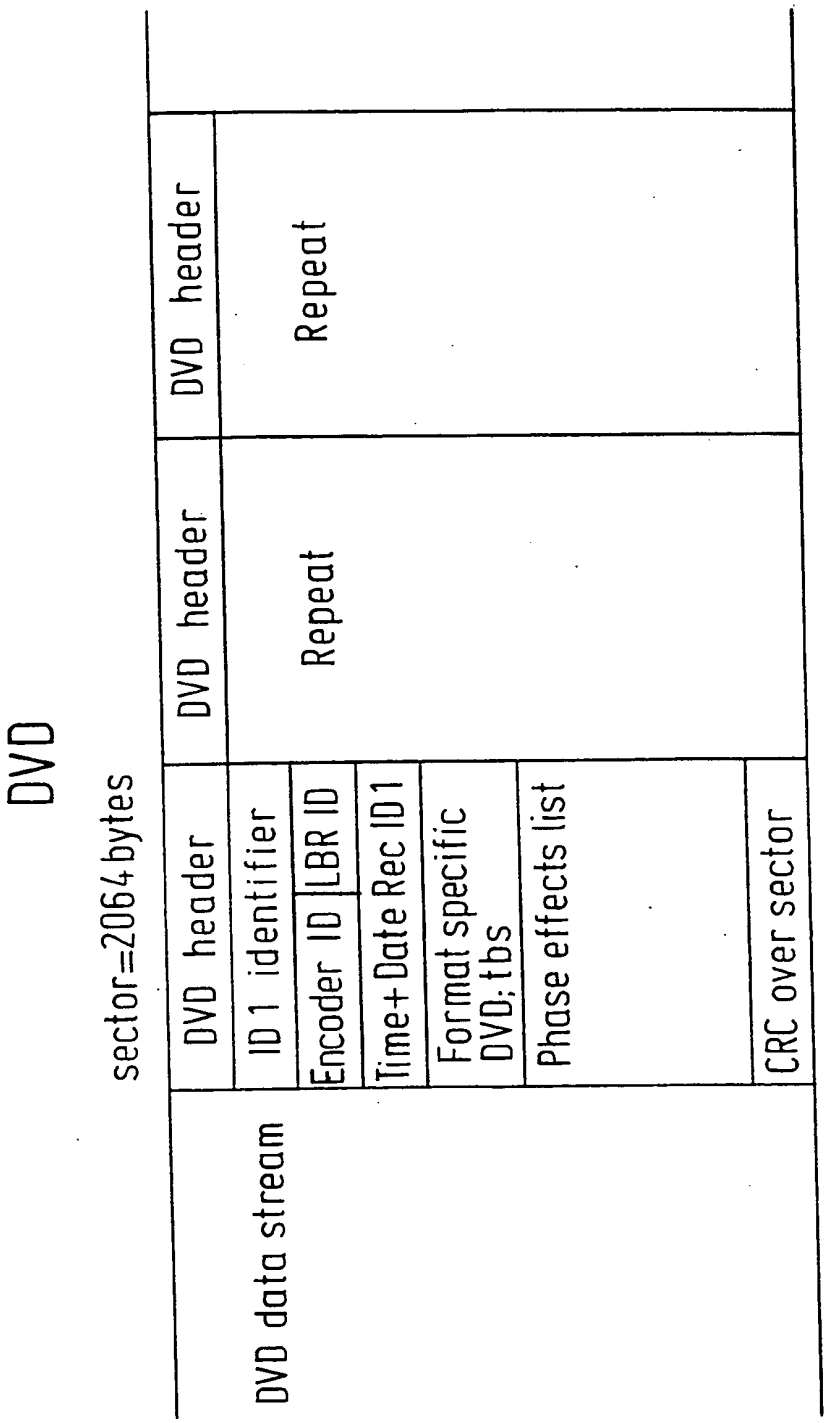
DVD
sector=2064 bytes
DVD data stream
DVD header
ID 1 identifier
Encoder ID
LBR ID
Time+Date Rec ID1
Format specific DVD; tbs
Phase effects list
CRC over sector
DVD header
Repeat
DVD header
Repeat
1 ECC block

FIG. 4

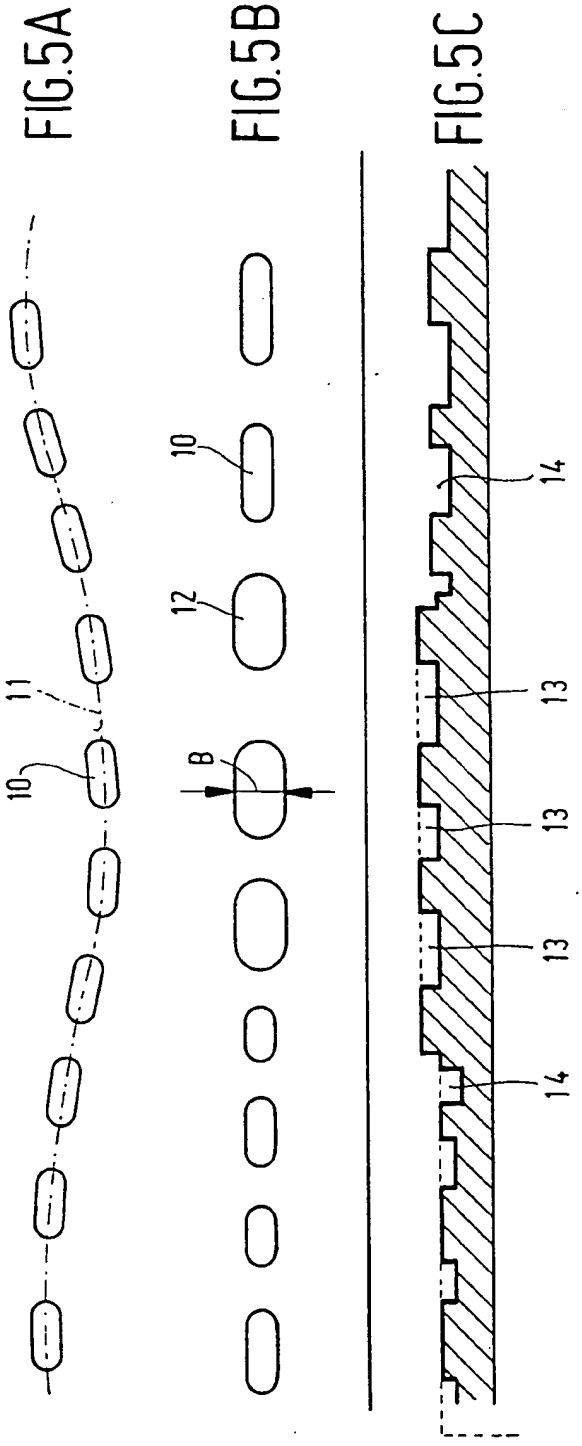
FIG.5A
FIG.5B
FIG.5C
10
11
12
B
13
14

INTERNATIONAL SEARCH REPORT

Inte onal Application No
PCT/NL 98/00556

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G11B20/00 G11B23/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G11B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 572 589 A (WATERS LESTER L ET AL) 5 November 1996 see abstract see column 3, line 31 - column 4, line 58; figure 4	1,9,11, 14,15
A		2-5,10, 12,16
A	NL 8 703 032 A (CHRISTIAN ALEXANDER OUDSHOORN) 3 July 1989 see claims 1,5-9	9,11,14
A	EP 0 129 427 A (DEFENDISK LTD) 27 December 1984 see abstract see page 4, line 5 - line 24 see page 7, line 3 - page 8, line 2	9,11,14

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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11 December 1998	17/12/1998

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Inte onal Application No
PCT/NL 98/00556

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